THE BIOLOGY OF *OPSIUS STACTOGALUS* FIEBER (HOMOPTERA, CICADELLIDAE)

by

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THE BIOLOGY OF OPSIUS STACTOGALUS FIEBER (HOMOPTERA, CICADELLIDAE)

TAXONOMIC HISTORY

Opsius stactogalus Fieber has had rather a restless position taxonomically. According to Olsen (1), "it has been shifted to and fro, and described in various genera, and in one case a genus was erected for it which was subsequently withdrawn, and the species put in an old and well-known genus".

The insect was described in this country by Doctor E. D. Ball (2) as Eutettix osborni from examples taken by F. H. Snow in Galveston, Texas, in 1907. No food plant is mentioned. Some years later, September, 1920, while he was calling at the American Museum of Natural History in New York City, he found specimens of the insect on Tamarix near the Museum, though they had been known thus far to occur only in Texas and California, also on Tamarix. Mr. Olsen also secured specimens of the hopper and on trying to have the Tamarix species determined, he found the plant was an European importation. Thinking the hopper might have been imported with the host, Mr. Olsen sent specimens to E. de Bergevin of Algiers, requesting him to compare

them with European leafhoppers. Bergevin identified the so-called Eutettix osborni Ball as Athysanus stactogalus Fieb. In the meantime Olsen received a box in exchange from Mr. W. Lallemand of Brussels, Belgium, containing the same little leafhopper also labeled Athysanus stactogalus, Fieber.

In going over the available literature, Olsen found that Amyot in 1847 had described the insect briefly as Stactogala, (3) neglecting to use the binomial nomenclature. Fieber (1866) erected the genus Opsius for Amyot's Stactogala (4). Thus the species becomes a Fieberian one, as Amyot's name could not stand through disregard of the zoological rules. Fieber later (1872) seemed to regard his new genus synonymous with Athysanus, for, in his "Katalog der europaeischen cicadinen" he lists the insect in the genus Athysanus (5). Jassus, Thamnotettix, Opsius and Limnotettix are given as synonyms. From that time on the hopper was known in European literature as Athysanus stactogalus, Amyot. Oshanin (1912) lists the insect as Athysanus stactogalus giving credit for the first time to Fieber (6). Therefore, the American Eutettix osborni, Ball determined by two European specialists as Athysanus, becomes a synonym for Athysanus stactogalus, Fieber,

Athysanus being considered a subgenus of Euscelis. Ball (1929) in his key to the American genera of the old group Athysanus (Euscelis of the Van Duzee catalogue) omits Stactogalus, Fieb. making a note that it belongs to the genus Opsius Fieber and that Opsius stactogalus, its type, is much more closely related to Eutettix than it is to Athysanus (7).

HOSTS

Opsius stactogalus has been taken a number of places in the United States and with one exception Tamarix sp. has been given as the host plant. Gibson and Cogan (1915) reported the hopper on "white aster used in ornamental planting (8)". Olsen (2) suggests that "it would be exceedingly interesting to know if the insects lived and thrived on this plant or if they were only casual visitors from a nearby Tamarix as both plants are extensively used in ornamental planting".

The most common Tamarix species in eastern Kansas is Tamarix gallica. It is native to the Mediterranean region and has been under cultivation since 1596 (9). This species has been found in the United States for a number of years. It has become naturalized in Southern Texas and New Mexico, and has also been found growing wild along the Arkansas River in Kansas and Colorado,

Tamarix africana is a species much less common in Kansas than Tamarix gallica, as it is not so thrifty in this climate. All the specimens of T. africana in this locality were infested with Opsius stactogalus, but the number of the insects was small compared with the thousands living on a single plant of T. gallica. The little pale green nymphs and adults are conspicuous against the bright green foliage and purple stems of T. africana, but scarcely noticeable against the glaucous green background of T. gallica.

Although many of the shrubs were so infested with thousands of the active little hoppers that they seemed to be alive with them, there was no noticeable damage to the shrub itself. Tamarix gallica has a luxuriant growth, particularly after it has been cut back previous to the growing season. It must be thrifty to support its own growth apparently unharmed as well as furnish sap for the thousands of little beaks which are daily inserted for food. The practice of trimming back the shrubs to within eighteen inches of the ground every other year keeps the number of hoppers down, as the larger percent of the overwintering eggs which are usually laid in the small branches, are destroyed.

NUMBER OF GENERATIONS.

Observations in the field from the first of May to the last part of November indicate that there are three generations of Opsius stactogalus a year. The eggs for the first generation are laid in the fall and hatch the next spring. The last adults of that generation were gone by June 29. First instar nymphs of the second generation were found in the field on the same date. The first adults appeared July 18. The last of the fifth instar nymphs of that generation were taken August 14. There was no time between the second and third generations when adults were not to be found, as there was between the first two generations, but there was a period from August 20 to September 6 when there was a decided decrease in the number of individuals. This discrepancy is explained by the difference in the lengths of the egg stage for the second and third generations. The average length of time for the egg stage of the second generation was 18.2 days. This was doubtless due to the weather. At the time the second generation eggs were developing in June, the weather was cool and rainy. The temperature during August was much higher and the length of the egg stage, averaging 11.3 days, was reduced. Consequently, the adults of the third generation appeared before those of the second generation had all disappeared.

TECHNIQUE FOR REARING.

The numphs of Opsius stactogalus are small and very active. Their pale green coloring is so near that of their host, Tamarix gallica, that finding one on a given stem is a difficult matter. In order to keep the little fellows in the laboratory so that they might be readily observed, it was necessary to keep them confined, each in a one dram glass vial, plugged with cotton. During the first part of the season the older nymphs did very well with a small piece of Tamarix stem of convenient size inserted twice daily for food. This method proved unsatisfactory for the small nymphs and for the older ones during the hot part of the season for the stem soon wilted and the nymphs were unable to get sap from them. The nymph was placed in a vial on the tip of a Tamarix twig, from eight to ten inches long and the mouth of the vial then plugged with cotton. The other end of the stem was placed in a small jar filled with water. The vial was allowed to rest on a box, a cigar box proving to be a satisfactory height, or on the table if the length of the stem permitted. Part of the leaves were stripped from the portion of the stem which was not confined in the bottle to prevent too rapid transpiration and the wilting of the branch. It was necessary to be careful not to strip off too many leaves

as moisture would gather inside the bottle, which favored fungous growths on the insects. The stems were changed daily.

The adults were kept in larger cages. Stems of Tamarix ten to twelve inches long were inserted several inches into four inch flower pots filled with sand, which was kept wet. The insects were confined on the stem by a number two lamp chimney, the top of which was covered with cheese cloth. This method was not entirely satisfactory. The adult hoppers were so active that a good many, the males particularly, escape while the food was being changed.

EMERGENCE IN SPRING.

Opsius stactogalus overwinters in the egg stage. The first nymphs probably appeared during the first week in May, 1928, and continued to emerge for the next two weeks. During the spring of 1929 the first nymphs were found May 9. The nymphs go through five instars, which takes approximately a month.

DESCRIPTION AND LENGTH OF STAGES.

The Egg.

Length 0.75 mm.; width 0.33 mm.; elongate ovate, tapering to a point at one end, the other rounded; white in color, somewhat transparent, with the surface smooth.

Length of Egg Stage.

Second generation, average 18.6 days.

No. Eggs	Laid	Hatched	Time
1	June 14	July 3	19 days
1	June 16	July 4	18 days
1	June 16	July 4	18 days
1	June 16	July 5	19 days
1	June 16	July 5	19 days

Third generation, average 11.3 days.

No. Eggs	Laid	Hatched	Time
2	August 8	August 17	9 days
4	August 8	August 18	10 days
6	August 9	August 21	12 days
5	August 12	August 24	12 days
1	August 12	August 24	13 days
2	August 12	August 26	14 days
1	August 12	August 27	15 days
6	August 15	August 27	12 days
17	August 17	August 29	12 days

First Instar.

Size: Average length 0.81 mm.; width across eyes 0.35 mm.

Color: The newly hatched nymph, pearly white with reddish-brown eyes. By the second day, abdomen slightly yellow; third day nymph uniformly pale yellow or yellowish-green.

Length of Stage Average 6.16 days

No. of numphs	Hatched	First molt.	Time.
1	July 4	July 10	6 days
4	August 10	August 16	6 days
1	August 13	August 19	6 days
2	August 17	August 24	7 days
1	August 18	August 24	6 days
1	August 19	August 25	6 days
1	August 21	August 28	7 days
1	August 24	August 30	6 days
1	August 27	Sept. 3	7 days
2	August 27	Sept. 2	6 days
10	August 29	Sept. 4	6 days

Second Instar

Size: Average length 0.96 mm.; width across eyes 0.43 mm.

Color: Pale green. White or light median dorsal stripe running the full length of the body. Yellow area on anterior and lateral margins of vertex, lateral margins of pronotum and outer edges of the wing pads. Eyes brown.

Length of Stage. Average 5.92 days.

First Molt	Second Molt	Time
July 12	July 18	6 days
July 7	July 14	7 days
July 9	July 16	7 days
July 10	July 16	6 days
July 12	July 18	6 days
July 24	July 30	6 days
July 24	July 30	6 days
August 4	August 10	6 days
August 3	August 9	6 days
August 2	August 8	6 days
August 16	August 21	5 days
August 16	August 21	5 days
August 16	August 22	6 days
August 16	August 22	6 days
August 24	August 31	7 days
August 27	Sept. 1	5 days
August 28	Sept. 4	7 days
August 27	Sept. 3	7 days
August 27	Sept. 3	7 days
August 30	Sept. 4	5 days
Sept. 2	Sept. 8	6 days
Sept. 4	Sept. 9	5 days
Sept. 4	Sept. 10	6 days
Sept. 6	Sept. 11	5 days

Third Instar

Size: Average length 1.25 mm.; width across eyes, 0.56 mm.

Color: Same as for second instar. In addition there are four longitudinal rows of white dots on the abdomen, two on either side of the mid-dorsal line, one row near the lateral margin of the abdomen and the other half way between the lateral row and the mid-dorsal line. There are also white flecks on the vertex, prothorax

and wing pads. . In many individuals there is an area of dark brown stippling toward the lateral edges of the last three abdominal segments.

Length of Stage. average 6.4 days.

Second Molt	Third Molt	Time
July 7	July 15	8 days
July 8	July 15	7 days
July 10	July 17	7 days
July 10	July 17	7 days
July 15	July 21	6 days
July 15	July 21	6 days
July 15	July 21	6 days
July 17	July 25	8 days
July 18	July 25	7 days
July 18	July 25	7 days
August 21	August 27	6 days
August 21	August 28	7 days
August 22	August 28	6 days
August 22	August 29	7 days
August 23	August 28	5 days
Sept. 1	Sept. 8	7 days
Sept. 1	Sept. 7	6 days
Sept. 3	Sept. 8	5 days
Sept. 3	Sept. 10	7 days
Sept. 4	Sept. 10	6 days
Sept. 8	Sept. 14	6 days
Sept. 9	Sept. 14	5 days
Sept. 11	Sept. 16	5 days

Fourth Instar

Size: Average length 2.19 mm.; width across eyes 0.86 mm.

Color: Same as third instar. Stippling found on lateral margins of the last five abdominal segments, on the first pair of wing pads, the medio-caudal area of

the prothorax, median and lateral areas of the vertex. Small dark brown triangle on caudal margin of the second pair of wing pads, slightly more than half way from the mid-dorsal stripe to the lateral edge.

Length of Stage. Average 6.54 days.

Third Molt	Fourth Molt	Time
July 8	July 15	7 days
July 15	July 22	7 days
July 15	July 22	7 days
July 15	July 22	7 days
July 22	July 29	7 days
July 25	August 1	7 days
August 5	August 11	6 days
August 17	August 23	6 days
August 21	August 28	7 days
August 21	August 27	6 days
August 21	August 27	6 days
August 21	August 27	6 days
August 27	Sept. 3	7 days
August 28	Sept. 3	6 days
August 28	Sept. 4	7 days
August 28	Sept. 4	7 days
August 29	Sept. 5	7 days
Sept. 7	Sept. 13	6 days
Sept. 8	Sept. 14	6 days
Sept. 14	Sept. 20	6 days
Sept. 4	Sept. 10	6 days
Sept. 16	Sept. 22	6 days

Fifth Instar

Size: Average length 3.06 mm.; width across eyes, 1.2 mm.

Color: Same as fourth instar. Stippling on all the abdominal segments but not confined to the lateral

margins on the last five segments. Wing pads heavily stippled on the lateral portions, giving them a brownish appearance. Stippling also on median and lateral portions of prothorax and vertex.

Length of Stage. Average 6.83 days.

Fourth Molt	Fifth Molt	Time
June 7	June 14	7 days
June 8	June 16	8 days
June 13	June 20	7 days
June 13	June 20	7 days
June 13	June 20	7 days
June 15	June 23	8 days
June 22	June 30	8 days
August 1	August 7	6 days
August 6	August 12	6 days
August 23	August 30	7 days
August 27	Sept. 2	6 days
August 27	Sept. 2	6 days
August 28	Sept. 4	7 days
Sept. 3	Sept. 10	7 days
Sept. 3	Sept. 10	7 days
Sept. 4	Sept. 11	7 days
Sept. 4	Sept. 11	7 days
Sept. 13	Sept. 20	7 days
Sept. 14	Sept. 21	7 days
Sept. 14	Sept. 20	6 days
Sept. 20	Sept. 27	7 days
Sept. 22	Sept. 28	6 days
Sept. 22	Sept. 28	6 days

Adult.

Deep green, the elytra with milky flecks and smoky apices.

Size: Female 4.5 mm.; male 4 mm.

Structural Characteristics:

Head: Distinctly wider than prothorax. Vertex two and one-half times as wide as long, slightly longer at middle than next the eye, broadly rounding to front. Front broad, margins of clypeus parallel.

Pronotum: Twice as long as vertex, two and one-third times as wide as long, anterior margin broadly convex, posterior margin slightly concave, lateral margins greatly reduced, humeral margins distinct.

Scutellum: Normal.

Elytra: Distinctly longer than abdomen, closely folded giving a wedge-shaped appearance to the insect, venation rather obscure, especially apically.

Genitalia: Last ventral segment of female three times as long as preceding, posterior margin produced medially with very slight median notch; visible portion of pygofer two and one-half times length of last ventral segment, sparsely spined; ovipositor approximately the same length as pygofer. Male valve equilaterally triangular, three-fourths the length of last ventral segment; plates long, tapering, acutely pointed, exceeded but slightly by pygofer, lateral margins with long hairs.

Color: Eyes dark brown. Vertex and anterior portion of prothorax pale green, often yellowish-green, posterior half of prothorax deep green. Scutellum yellow, transverse depression black, frequently two to four dark spots along anterior margin. Elytra deep green to just beyond the dark apex of the clavus, then smoky, sub-hyaline, often dotted with white flecks; costa with lighter area in region of costal plaque, two smaller light areas posteriorly, the three light areas separated by darker costal spots. On some individuals minute black dots on elytra, prothorax and vertex. Face and venter pale green.

MATING AND OVIPOSITION.

Mating may take place any time after the insects become adult. Pairs in copulation may be found in the field almost any time that adults are present. The pre-oviposition period varied from 7 to 12 days in those individuals which were kept in the laboratory. The average time was 10.3 days.

Female became adult.	First Eggs	Time
July 23	August 3	11 days
July 33	August 4	12 days
July 26	August 7	12 days
July 28	August 4	7 days
July 28	August 7	10 days
August 2	August 12	10 days

Eggs are placed beneath the bark of younger stems and branches and beneath the epidermis of the small green shoots. They are usually placed in an oblique position but are often found transversely across the stem. When ovipositing, the female rests her body on the first two pairs of legs, the ovipositor is unsheathed, brought down perpendicularly to the stem and inserted in it about half of its length, with small pushing movements. The average time for the process is one minute. The number of eggs laid by one female in the laboratory was 53 in an oviposition period of 10 days. Another laid 58 eggs in a period of 13 days. The number of eggs laid per day by the two is as follows:

Female No. 1		Female No. 2	
July 23	Became adult.	August 30	Became adult.
August 4	4 eggs	Sept. 10	3 eggs
August 5	3 eggs	Sept. 11	4 eggs
August 6	3 eggs	Sept. 12	3 eggs
August 7	10 eggs	Sept. 13	7 eggs
August 8	17 eggs	Sept. 14	7 eggs
August 9	5 eggs	Sept. 15	10 eggs
August 10	6 eggs	Sept. 16	6 eggs
August 11	1 egg	Sept. 17	6 eggs
August 12	2 eggs	Sept. 18	4 eggs
August 13	2 eggs	Sept. 19	3 eggs
August 14	0 eggs	Sept. 20	2 eggs
August 15	0 eggs	Sept. 21	0 eggs
August 16	0 eggs	Sept. 22	3 eggs
August 17	0 eggs	Sept. 23	0 eggs
August 18	0 eggs	Sept. 24	0 eggs
August 19	dead	Sept. 25	0 eggs
		Sept. 26	dead

On many of the shrubs there were only a few individuals of the first generation, due to trimming back the shrub which destroyed many of the overwintering eggs, and to the activity of parasites the previous fall. There was a great increase in numbers for the second generation. At the time of maximum abundance of the third generation individuals, the shrubs were alive with them. This great increase in spite of the presence of parasites indicates a fairly high rate of productivity.

LONGEVITY OF ADULTS.

The adults of Opsius stactogalus live one month on an average. Field observations from the time the first adults of a generation appeared (July 18) until the decrease of their numbers (August 20), or from the time the last nymphs were found (October 10) until the last adults disappeared (November 15), indicate the length of life to be close to a month. The maximum period for individuals reared in the laboratory was 38 days for females, one becoming adult on June 12 and living until July 20, and 29 days for males, one becoming adult July 24 and living until August 22.

DISAPPEARANCE IN THE FALL.

Adults were found in large numbers until the middle of October. There was a gradual decrease until the first of November. Examinations were made daily. A few hoppers could always be found during the next two weeks, usually feeding on the larger branches. Hoppers were last seen alive November 15. There was a cold rain on November 16 and 17, and a heavy frost the night of the 18th. No live hoppers could be found on November 19.

NATURAL ENEMIES.

Throughout the summer, eggs of lace wing flies (Chrysopidae) were common on the Tamarix. The larvae were often seen running up and down the stems, searching for food. There were no aphids on the shrubs and thinking the nymphs of Opsius stactogalus might be the prey of the Chrysopid larvae, a number of nymphs were caged in a small vial with one of the larvae, resulting in the destruction of the nymphs. The larva was reared to an adult, fed on nymphs of the hopper.

A single fifth instar nymph was taken June 13, which had been parasitized by one of the Hymenopterous parasites, a Dryinid. The parasite appeared as a small

dark sac hanging from between the mesothorax and metathorax, on the lateral side. The nymph lived nine days, which was past the time when it normally would have molted, without doing so. It died June 22. Two fifth instar nymphs were found on October 2 which had been similarly parasitized. They lived only two more days. The Dryinid larvae left the dead bodies of their hosts. They were very active, crawling on their backs by peculiar peristaltic movements, searching for a place to make their cocoons. They were put in vials half full of dirt. The larvae immediately crawled beneath the surface of the soil and by the next day were spinning their overwintering cocoons. The Dryinidae would be effective parasites of Opsius stactogalus Fieb. if they occurred in large enough numbers. Only three parasitized specimens were found among the hundreds of nymphs that were brought into the laboratory from the field.

The most effective enemy of the Tamarix leafhopper is the Chalcid fly Polynema saga Girault, belonging to the family Mymaridae. This species had been known only from the type specimen in the United States National Museum, taken by H. S. Barber at Washington, D. C., in 1905, until discovered in large numbers by Dr. P. B. Lawson on the University of Kansas campus during the summer of 1927.

The females of this minute egg parasite could be seen running up and down the branches, with their antennae constantly feeling the surface of the stem to locate the host eggs which appear externally as small blister-like swellings. Having found a suitable location, the fly places herself lengthwise of the egg, inserts her ovipositor leaving her own tiny egg within that of the host egg. She then continues her search. The adults were seen occasionally during August, but were not numerous until the early part of October. By that time the Tamarix stems were almost covered with the hopper eggs and the activity of the parasites was very noticeable.

Early in November while dissecting eggs of Opsius stactogalus, one specimen was noticed in which movements of the yolk material could be easily discerned even before the egg was completely uncovered. When removed to a watch crystal and covered with a drop of normal saline, the semitransparent egg showed within it the white larva of Polynema saga. The larva was quite active, the most common movement being that of the cephalic end lashing back and forth, causing churning movements of the yolk material.

The pupal stage of Polynema saga is also passed within the shell of the hopper egg. The adult emerges

through a round hole at the larger end of the egg which it cuts with the mouth parts, bit by bit, until it is large enough to admit emergence.

Over ninety per cent. of the overwintering eggs of the Tamarix leafhopper were parasitized during the fall of 1927. Counts of the eggs on stems taken at random for the year 1928 show but a little over twenty-five per cent. of parasitism. Occurring in large numbers and attacking the egg stage of its host Polynema saga destroys a much larger proportion of individuals of Opsius stactogalus Fieb. than do its other enemies.

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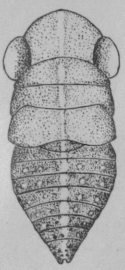

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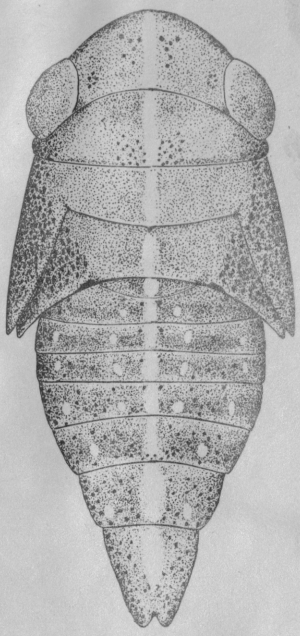

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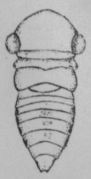

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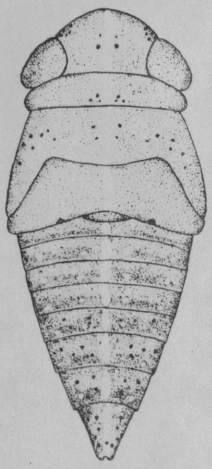

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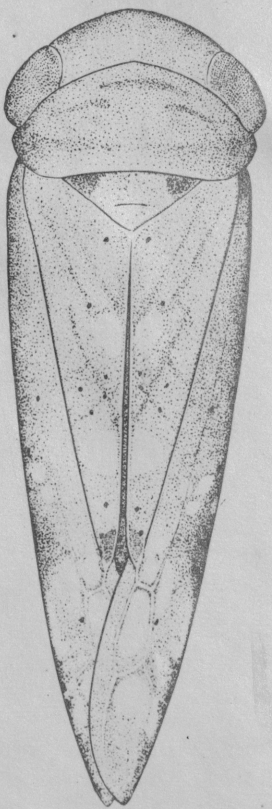

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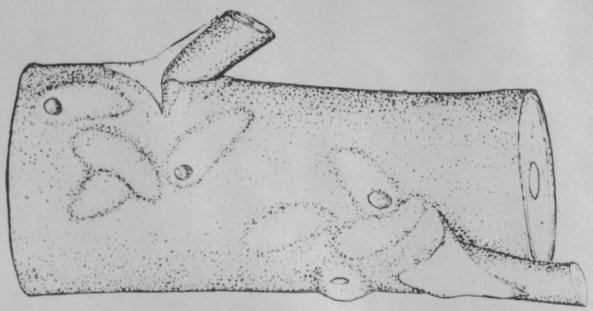

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LEGEND

1. Egg.
2. First Instar.
3. Second Instar.
4. Third Instar.
5. Fourth Instar.
6. Fifth Instar.
7. Adult.
8. Eggs in situ.

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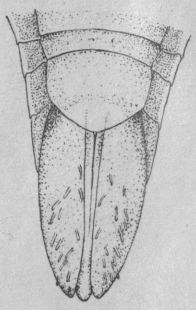

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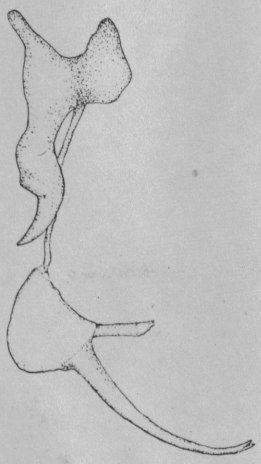

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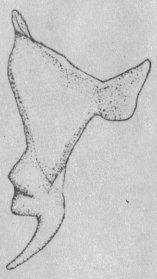

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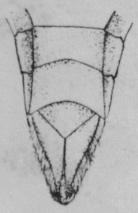

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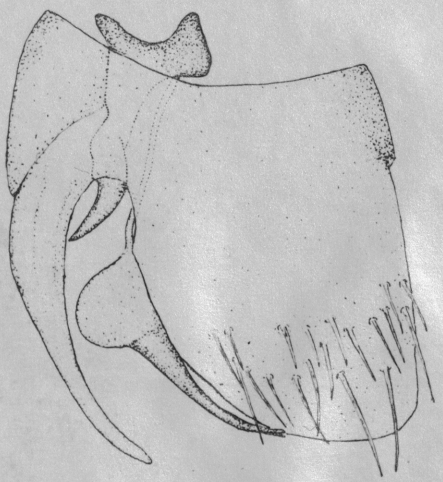

6

LEGEND

1. Inner valve of ovipositor.
2. External genitalia, female.
3. Internal genitalia, male.
4. Left clasper.
5. External genitalia, male.
6. Tip of abdomen, male.